ELECTRIC SCIENCE.

Eighth of a Series of Articles by C. J. Kintner, Principal Examiner, Class of Electricity, United States Patent Office.

Light, says Clark Maxwell, is a strain or force acting through a medium of transmission, and that medium, if we refer to sunlight, is the ether in space through which it transmits this strain from the sun to the eye. There is no wide difference in principle between the light emitted from a candle, a gas jet, the sun, or an electric lamp. Each kind of light, like sound and heat, is the result of rapid vibrations or undulations imparted to the elements of the medium through which it reaches the eye. We light a tallow candle with a friction match, which, in turn, is lighted by heat due to the vibrations imparted to its molecules by friction. In the candle, when once lighted, the action is purely chemical, in fact is nothing more nor less than a process of oxidation existing between the oxygen of the atmosphere and the combustible carbon of the tallow; this oxidation evolves heat, and the heat in turn is sufficient to set up rapid molecular vibrations in the air which affect the optical nerve in the nature of a sensation known as light, just as sound affects the auditory nerve by undulatory vibrations of air set up by a vibratory body. In the gas jet the process is much the same, the oxidation taking place between the element of carbon found in it and the oxygen of the atmosphere as before. With sun light the phenomenon is probably electrical rather than chemical, inasmuch as it and the electric light are almost identical in their nature, a fact made known by the spectrum, which gives almost the same analysis for both.

In the electric arc light the process is, in a measure, similar, or at least bears a general resemblance, to that of the candle or the gas jet inasmuch as there is some combustion, while in the incandescent light there is a radical difference, no combustion taking place at all. Before discussing this matter further we will first note the fact that the patent office recognizes three classes in the art of electric lighting, as follows: 1. Electric lighting; lights, arc. 2. Electric lights; lights, incandescent. 3. Electric lighting; lights, systems, and appliances.

By arc lights is meant all electric lights formed by the action of electricity at the junction of two electrodes, so that they waste away by combustion. This includes also what we sometimes denominate semi-incandescent lights, or those which burn only by incandescence or a glow at the junction of two electrodes without actual separation, and hence without an arc, such, for instance, as the Wardermann.

By incandescent lights we mean all electric lights which burn by virtue of the glow due to the heat generated by an electric current in a continuous conductor or filament as in the Edison, the Weston, the Maxim, &c.

By systems and appliances we mean all apparatus involved in and necessary to the complete electric light plant; such as regulators, fixtures, fusible cut-outs, switches, complete systems of wiring, involving proportions, &c.

Electricity, as we have heretofore indicated, is simply an imponderable agent known only by its results.

It is in short not matter, but is a property of matter, and its peculiarities are more notably visible in the electric light than elsewhere. If a current of electricity be passed through a conductor it will generate heat in it according to a known law.

Now we know that a given amount of heat will develop a known amount of light; remembering that all light is the result of heat it is easy to arrive by this formula at a definite conclusion as to the amount of heat, and hence light, a given generator will develop, and under varying conditions. It is also known that a given amount of heat has its exact equivalent in work of energy. In other words that it takes a certain amount of work or energy to develop a specified amount of heat.

Knowing these facts we can readily compute what amount of horse-power or energy is required to develop a specified amount of heat and hence also of light. Of course the computations are quite complicated, as they involve many elements such as the quantity and quality of coal to be burned under the boiler, the character of the steam engine, the loss by friction of parts, the character of the dynamo, including its resistance, &c., the resistance of the outlying circuit including each lamp and the peculiar characteristics thereof, the leakage of current, &c.

As early as 1800 Sir Humphry Davy discovered that if two carbon pencils or electrodes be joined end to end in an electric circuit, with a battery of sufficient electro-motive force or pressure, say fifty Bunsen cells, and then the pencils be gradually separated, a brilliant light would result in the shape of a curve or arc between them until the points of the pencils had burned away too far to allow the current to pass. The arc thus formed is the result of the high resistance offered to the current of electricity at the ends of the carbons, and is caused by the glow or incandescence of a stream of carbon vapor flowing between the carbon points with the current of electricity. This was the origin of the electric light. It took its name from the brilliant curved arc always seen between the carbons of an arc lamp when they are separated a sufficient distance. Sir Humphry, elated at his discovery, supposed he had found a new method of artificial lighting, destined to revolutionize the art of illumination. Little did he imagine that it would be over three-quarters of a century before this form of light would be made available.

Two things prevented his success, viz., a proper regulator to keep the carbon points always at the same distance, and an economical generator to furnish the current at reasonable cost. In our article upon batteries it will be remembered we spoke of the wonderful amount of energy which has been exercised by inventors to produce a battery for this purpose, and yet without avail.

Early in this century a perfect arc-light regulator was developed for feeding the carbons, and as early as 1836 Messrs. Staite, Du Bosq, Sellon, Browning, and others had invented and patented in England arc lamps complete in every detail, and one of which, for use where only one lamp is required in a circuit, is perhaps as good as can be found to-day. To serve its purpose well an arc light should feed the carbons steadily and with such regularity as to prevent flickering or jumping of the light.

One of the earliest forms of the arc lamp, and one of the best, the Sellon, is composed of the framework sustaining a spring-impelled-clock mechanism for advancing and retracting the carbons attached to rack bars actuated by the clock mechanism. This mechanism is controlled by an electro-magnet in the direct circuit with the carbon pencils, the armature of which acts as a detent to stop and release the mechanism so as to allow the carbons to be held or advanced as the current becomes stronger or weaker by virtue of their approach or separation. It will be understood that several of these lights can be operated on a single circuit for the reason that when the carbons of any one lamp become widely separated the magnets will feed the carbons in all the lamps at once, and thus soon feed them all together, except one pair, which will continue to turn after the others have gone out. The desirability to thus arrange lamps in series or tandem in a single circuit for commercial use, set electricians to solving the problem known as "dividing the electric arc" for the purpose of allowing each lamp to feed its carbons independent of the others. It was not solved until 1856 when two Frenchmen, Messrs. Lacassagne and Theirs, hit upon what is known as "the derived or shunt circuit" system, in which there are two electro-magnets for each lamp, one in the main or arc circuit, and another of very high resistance in a by-path or shunt circuit, passing entirely around the lamp. The first electro-magnet in the main circuit acts to separate the carbons, and the other electro-magnet acts against it and tends to cause the carbons to go together when they become too widely separated. The resistance offered by the arc as the carbons approach and recede causes the current to fluctuate between it—the arc circuit and the shunt circuit—and thus regulate the feed of the carbons. The mechanism, however, was clumsy, and the lamp is now of no special value, except that it stands as the parent of what is known as the shunt or by-path system of dividing the arc, which is now generally used in all arc light systems, and notes an important step in arc lighting.

Next, in 1877, came Brush, Heffner, Alteneck, and Weston, who improved upon the lamp of Lacassagne and Theirs, and made it practical by improving the mechanical parts so that to-day the Brush company are running as high as eighty lights in a single circuit, with a dynamo machine having an enormous electro-motive force.

There exists very lively competition in arc lights, and there have been granted to date more than 500 patents. An important lamp was made by Jablochkoff, which is simple and ingenious. It is known as the electrical candle, and is designed to do away with all regulating apparatus. It consists of two carbon sticks separated by a fusible insulating material, and having a lighting or arc-starting device at their upper end. Several of these lamps are connected in series, and the arc forms on starting the dynamo between the ends of the carbons, and as they burn down the fusible material is burned away. The simplicity of this lamp commends it, and it is largely used in Paris.

The arc lights generally in use in this city are known as the Thomson and Houston pattern, and are what are styled positive feed, being almost entirely free from flickering and of great efficiency. Their steadiness is due to the positive feed, and also to an efficient regulator at the dynamo machine.

Our systems of arc lighting are very complete, and for street use or large areas there can be no question as to their superiority over gas or other existing artificial lights.

The incandescent lamp, like the arc, came into existence early in the present century, and was forced, like its fellow, the arc lamp, to await the advent of an economical generator of electricity.

The first lamp of this character of which we have any reliable record was invented by Starr King, a young man from Cincinnati, Ohio, as early as 1835.

It consisted of a carbon strip bent in horseshoe form and inclosed in an exhausted globe of glass, to the exposed ends of these strips a battery was connected, and if an electrical current of sufficient quantity was forced through it, a brilliant light resulted by reason of the rapid vibrations transmitted to the molecules of the carbon by the passing current. Combustion is rendered impossible because the globe is devoid of oxygen. King, elated with his prospects, went to England to take out patents. He met with great encouragement, but was swindled out of his English patents by an unscrupulous scoundrel, and he ultimately returned to America and died broken-hearted. He never patented it in America.

But little was done in the art in advance of what King had done until Koen Kossloff, Sawyer and Mann, Edison, Weston, and Swan came into the field, from 1871 to 1880.

The lamps of these inventors do not differ in any startling manner among themselves, and are all based upon the idea developed by King, that it is necessary to prevent combustion of the filament by exhausting the air.

Sawyer and Mann filled the globe with nitrogen and other non-combustible gases. To Edison, perhaps more than to any other modern inventor, belongs the credit of having developed the incandescent lamp to its present point of efficiency, for the reason that he saw the necessity of as complete exhaustion of the globe as possible, and of furnishing each lamp with as high resistance as possible, so that many lamps can be connected in what is known as multiple arc, that is to say, connected side by side between two main conductors, so that each lamp takes its proportion or quantity of the current from the two main wires connected to the dynamo. In arc light systems the lamps are connected in series or tandem, so that when all the lamps are in operation the resistance offered to the passage of the current through the circuit will be equal to that of the conductors joining the lamps plus the sum of the air spaces made by the separation of the carbons at the arc, so that if, as in the Brush system, we have eighty lights whose carbons are separated each about an eighth of an inch, there will be a total space of 80 divided by 8, or 10 inches, to be bridged by the current. Now, the resistance of an arc lamp varies from three to five ohms or units of resistance. A circuit containing eighty lamps, or about 300 ohms resistance, would require an enormous electro-motive force.

Now the quantity of current in such a system is a constant factor, while the tension or pressure should vary directly with the number of lamps because the resistance increases in the same proportion.

With incandescent lamps the reverse is true, for the reason that as we add lamps we decrease the resistance; for we are by so doing offering new or additional paths for the current and each path so added offer a decrease of resistance to the total electric current. Hence in such a system we must keep the electro-motive force or pressure constant and increase the quantity of current; for heat and hence light, as we have seen, is developed directly in proportion to the square of the quantity of current flowing.

In the Edison lamp a fine filament of carbonized bamboo is used. In the Crookes lamp the filament is made of animal or vegetable matter, while in the Maxim it is carbonized paper. Swan uses carbonized thread, and Weston what is known as "tamadine," an amorphous substance composed of carbonized celluloid.

With this material he is enabled to produce filaments of higher resistance for a given diameter and length than with any substance heretofore known. It is also very durable, and constitutes a decided advance in the art.

There has of course been marked improvement in matters of details accompanying these systems of lighting, which lack of space prevents us from commenting upon.

In our opinion, there is no question as to the feasibility of electric lighting for domestic use. As to its cheapness there can be no doubt, for the reason that the health-preserving qualities of the incandescent light are of such vital importance that the consumer should not hesitate for a moment to consider its cheapness established in point of fact, though the actual cost be double that of gas.

If we stop to consider that each gas jet in a room does more to vitiate the atmosphere than the breathing of two persons: that it heats unduly in summer time; that danger of fire is four-fold more than with the incandescent light; that for cleanliness gas is not to be compared with it; that its light is steadier, brighter, and easier upon the eyes: that it is more like sunlight than any existing artificial light, and that it is odorless, we will not hesitate to accept it at any price within our means.

There is no question but that the systems of incandescent lights are feasible in sections where the power can be centrally located, and particularly is this true where water power is available.

We prophesy a wonderful future for this kind of lighting, and this, too, not far distant.

The concluding articles of this series, two in number, upon the telephone and phonograph, will not be prepared for publication until the latter part of January.

Nervous Debilitated Men.

You are allowed a free trial of thirty days of the use of Dr. Dye's celebrated Voltaic Belt, with electric suspensory appliances for the speedy relief and permanent cure of nervous debility, loss of vitality and manhood, and all kindred troubles; also for many other diseases. Complete restoration to health, vigor, and manhood guaranteed. No risk is incurred. Illustrated pamphlets, with full information, terms, &c., mailed free by addressing Voltaic Belt Company, Marshall, Mich.

The Result of Democratic Example.

[Columbus Dispatch (Ind.)]

History in a nutshell: Slavery! War! Freedom. Enfranchisement of the late slaves. Quarrel about this enfranchisement. Alleged fraud and intimidation by the late slaveholders against the newly enfranchised freedmen. Alleged fraud by the friends of the freedmen in a professed attempt to do them justice. Out of this, and spreading into states that hitherto had an honest ballot and a fair count, sprang the Cincinnati contest. These things cannot stop, if fostered; and if not stopped, what is to become of the country? But one result is possible. The people are all right. The scheming men who are grasping for political power, and the thieves and forgers who are assisting them, must be suppressed.

A Valuable Medical Treatise.

The edition for 1886 of the sterling Medical Annual, known as Hostetter's Almanac, is now ready, and may be obtained, free of cost, of druggists and general country dealers in all parts of the United States, Mexico, and indeed in every civilized portion of the western hemisphere. This almanac has been issued regularly at the commencement of every year for over one-fifth of a century. It combines, with the soundest practical advice for the preservation and restoration of health, a large amount of interesting and amusing light reading, and the calendar, astronomical calculations, chronological items, &c., are prepared with great care, and will be found entirely accurate. The issue of Hostetter's Almanac for 1886 will probably be the largest edition of a medical work ever published in any country. The proprietors, Messrs. Hostetter & Co., Pittsburg, Pa., on receipt of a 2 cent stamp, will forward a copy by mail to any person who cannot procure one in his neighborhood.

THE PRISONER WEPT.

Passengers on a Sing Sing Train Sympathize with a Desperate Looking Man.

[New York Sun.]

Four well-dressed men occupied a double seat on a train of the Hudson River railroad that left New York at 9 o'clock on the morning of one day last week. The one who sat nearest the window and facing the forward end of the car was a man of medium stature who wore a sandy mustache and seemed very much depressed. He kept his eyes fixed upon the floor most of the time. Occasionally he sighed deeply, and cast wistful glances out of the window as the train rushed past the fields and woods. His companions paid little attention to him, but conversed among themselves.

Soon after the train left Peekskill one of the men stopped a brakeman who was going through the car, and asked quietly:

"Will you bring the prisoner a glass of water?"

The brakeman brought the water, and in less than five minutes word was spread through the car that the sad man by the window was a prisoner on his way to Sing Sing, and that the three men with him were sheriff's deputies, who had him in charge. Men and women turned in their seats to look at the unfortunate, and when the conductor came through to look at the tickets he asked in a whisper:

"What's his name?"

"Mackay," replied one of the deputies; "John W. Mackay."

"I've heard his name," said the conductor. "Let's see; what was't he was convicted of?"

"Forgery; ten years," responded the other.

"Oh, yes, I remember; desperate-looking man," the conductor said, and went on his way.

The prisoner's name was spread throughout the car, and when the length of his term was made known greater curiosity than ever was indicated by the passengers. Men came in from the other cars to look at him. When the prisoner happened to look up and found himself the center of observation, he at once cast his glance to the floor again, and a moment later great tears were seen rolling down his face.

"Come now," said the big man with a black mustache who sat at his side, "what are you blubbering about?"

The other made no answer, but wept silently. The eyes of some of the lady passengers began to grow moist. Presently a sweet-faced old lady came over to the seat where the prisoner sat and said, with tears streaming down her face:

"I can't tell you how much I feel for you, but please let me give you this Bible, and please promise to read it. You don't know how much it will comfort you."

Other ladies were crying, too, by this time, and some of the male passengers felt called upon to blow their noses rather oftener than usual. But the black-mustached man, who sat next to the prisoner, seemed to restrain laughter with some difficulty, and he finally stuffed his handkerchief in his mouth and isolted to the end of the car.

"You're a brute," said an old gentleman, who sat near the door.

"I suppose so," said the black-mustached man, gruffly; "but if you'd taken as many men up the river as I have you'd laugh, too, when the passengers went silly over 'em."

When the train stopped at Sing Sing the four men arose, and, with the prisoner in the middle, walked out of the car, while the passengers opened their windows and gazed at them on the platform. Just before the train started on one of the men brought back the Bible and handed it in the window to its owner.

"He can't read," he said.

Then, to the excitement of everybody, the prisoner suddenly bolted up the road, and before the two men left with him could recover their senses he had a hundred feet start. All three rushed after him; but, to the disgust of the passengers, the train started away and they were unable to witness the denouement.

After the train had gone the prisoner, to the surprise of the hands, came back to his jailers, and all four laughed long and loud. The four men were Mackay, the comedian; Edward Aronson, of the Casino; Robert Hilliard and Maurice E. Strauss, who were on their way to visit Sing Sing prison, and had "played" Mackay off as a prisoner for their own amusement.

"It made me feel mean to take in that nice old lady," said Mackay; "but I can lick the conductor who said I looked desperate."

Nothing Like It.

[New York Sun.]

Never was such a last testament known of mortal as that printed in the Sun yesterday. Kings have died with full treasuries, emperors have fled their realms with bursting coffers, great financiers have played with millions, bankers have reaped and sowed and reaped again, great houses with vast acres have grown and grown and still exist; but never before was such a spectacle presented of a plain ordinary man dispensing, of his own free will, in bulk and magnitude that the mind wholly fails to apprehend, tangible millions upon millions of palpable money. It is simply grotesque.

The numerical significance of a million is incomprehensible; it can only be measured relatively and by illustration, and when it comes to dealing with hundreds of millions the understanding is overwhelmed and helpless. Mr. Vanderbilt gave them right and left, as if they were ripe apples.

And it came out of Wall street. How many dollars of that immeasurable volume of riches were made in the channels of legitimate commerce, in manufactures, in the fruition of toil, the accretion of improved realty, or in any strictly normal fashion whatever? It is the most extraordinary consideration connected with it that it was mostly acquired by that form of modern industry which consists simply in getting the better of somebody. Not gambling, by any means, although it is commonly classified as gambling, and is gambling so far as the majority of its practitioners are concerned. But for the paternal Vanderbilt and his late son it was something very different. It was the same art as that of the sublimated peddler who flew his pigeons from Waterloo to London and founded the greatest banking house in the world—the art that controls speculation and is never subjected to its vicissitudes. To buy a thing at less than its value and to sell it at what it is not worth defines the principle that is involved. It is what all who speculate seek to do. It is what the Vanderbilts could do and did. Dumas gave Monte Cristo only a beggarly pittance compared with what Vanderbilt left to each of eight children. And it came out of Wall street in a few years.

So extraordinary an example cannot be without effect. The conviction must be to many unavoidable that if other hands could wrest such prizes from that whirlpool of demoralization their chances are as good as any. For such it is gambling, pure and simple; and they are impervious to the lesson that is taught by the career of men like Vanderbilt, which shows that sooner or later the spoils must fall to the man behind the table, the man who, instead of taking the chances, controls them. It was Mr. Gould who said, "I never speculate." Neither did the commodore, and neither did his son. They left it to the public to do that.

Shows Up Smiling in the Final Round.

[Providence Journal.]

Hon. Wm. R. Morrison is at present victorious over the Hon. Samuel J. Randall, but it would be well for him not to rejoice too loudly until the session is over. The Pennsylvania statesman is a long-winded fighter.

INTELLIGENT MONKEYS.

How They Killed a Boa Constrictor With a Rock.

An officer stationed at Kalladgee, in India, was once climbing a rocky hill, when he and a native who accompanied him witnessed the following episode: A poor monkey was being slowly enwrapped in the voluminous folds of an enormous boa, its bones breaking like pipestems by the pressure. Gradually the reptile unwound itself, leaving a crushed, unrecognizable mass. The numerous monkeys on the rock were in the greatest state of excitement, running wildly about, gesticulating, chattering, and moaning, though of course powerless to help their comrade. While the snake was commencing its gorge, and before its body began to fill and swell, the officer and native went in quest of a stout cudgel and a sharp knife, expecting to make it an easy prey as soon as it should be filled to repletion. When they returned to the scene of the strife the boa lay thoroughly gorged beneath a projecting mass of cliff, looking more like a log than anything more lively. On the summit above a troop of monkeys were assembled, and three or four of the largest and strongest were occupied in displacing a massive fragment of rock, already loosened by the rains from the main ledge. By enormous exertion—made, too, with a silence quite unusual to monkeys—they at length succeeded in pushing the rock until it trembled just over the boa's head; then, uttering a yell of triumph, they dropped it over the miniature precipice. It struck the boa on the head, smashing it to a jelly. As its great tail lashed about ineffectually in its last struggle there was a general chorus of exultation—man joining his near relative, if we believe some of our instructors—over this well-accomplished act of vengeance.—[Good Words.]

A New Portrait of Gen. Lee.

When Gov. Marmaduke, of Missouri, was in New York some time since he was anxious to obtain a good steel engraving of Gen. Grant and one of Gen. Lee for the executive mansion at the capital of his state. He had no difficulty whatever in finding a number of excellent portraits of Gen. Grant, but failed to obtain one of Gen. Lee that was at all satisfactory. This led to a suggestion from him that John R. Reavis, of the New York World, should undertake the bringing out of a good steel engraved portrait of Gen. Lee. He said the time had passed when the animosities created by the war would interfere with the just appreciation of a work of this kind; that the death of Gen. Grant, the generous expressions toward his opponents in arms that fell from his lips during his last illness, and the publication of his personal memoirs would bring once more prominently before the public the leader of the confederate armies, and that he believed a faithful likeness would be well received. Mr. Reavis went to work at once to find materials from which the portrait should be engraved, and has adopted a photograph that meets with the approbation of Gen. Lee's son, Gen. Custis Lee.

This photograph, with other materials, has been placed in the hands of Wm. E. Marshall, whose portraits of Washington, Grant, Lincoln, and other distinguished Americans have given him the first place as the engraver of portraits on steel in this country and Europe. He has begun his work with enthusiasm, and will finish it early in the new year.

Palo Alto Stock Farm.

[New York Sportsman.]

Palo Alto stock farm, the magnificent estate recently dedicated by Senator Stanford to a California university, takes its name from a gigantic tree known as the Palo Alto pine, which rears its crest heavenward, a conspicuous mark for all residents of the fertile San Franciscuita valley, in which Palo Alto is situated. A little over a quarter of a mile from the station is a bridge across the San Franciscuita creek, and on the left, close to the edge of the ravine, is the famous Palo Alto, or lofty redwood pine, which is a landmark for all the country round. Nobody knows the age of the Palo Alto. It is about sixty feet tall, and is beautiful and majestic in form. There are not for many miles around any native redwoods. The twin brother of this one stood by it and was equally conspicuous and strong, but a few years ago was washed out of the soil by a freshet, and it now lies on the ground close to the bed of the stream. The senator has secured it so that it cannot be carried away by the young floods of the spring. The Palo Alto can be seen from every point of the valley, and, of course, from all the surrounding hills as far as the eye can reach. Senator Standford, next to his love of horses, loves the old forest trees. He is quoted as having said that he would as soon sacrifice the best horse he owns as this majestic tree, the time-honored Palo Alto pine.

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Deputy—H. A. Lockwood, corner 1st and B sts s w.

Customs Division—Chief, E. Jones, 507 6th st n w.

Bond Division—Chief, B. F. Cutter, 631 E Cap st.

Disbursing Officer's Division—Chief, N. H. Thompson, 1312 Riggs st n w.

Division of Appointments and Refunds—Chief, M. F. Holohan, 1112 10th st n w.

Stub Division—A. J. Gunning, 136 E Cap st.

REGISTER OF THE TREASURY.

Register—W. S. Rosecrans, Willard's Hotel.

Assistant Register—Ross A. Fish, 1238 Va av s w.

Note, Coupon, and Fractional Currency Division—Chief, L. W. Reid, Alexandria, Va.

Loan Division—Chief, James R. Sneed, 1228 11th st n w.

Receipts and Expenditures Division—Chief, J. H. Beatty, 128 11th st s e.

FIRST AUDITOR.

Auditor—J. Q. Chenowith, 1342 Vt. ave. n w.

Deputy—C. P. Baldwin, 142 A st. n e.

Customs Division—Chief, H. K. Leaver, 1528 16th st. n w.

Judiciary Division—Chief, Thaddeus Sturgis, 221 9th st. s w.

Public Debt Division—Chief, John P. Bentley, 915 L st. n w.

Warehouse and Bond Division—Chief, A. P. McMillan, 1314 13th st. n w.

SECOND AUDITOR.

(Winder's building, west of War Department.)

Auditor—W. A. Day, 27 Iowa circle.

Deputy—Henry C. Harmon, Howard ave., Mount Pleasant, D. C.

Paymasters' Division—Chief, David Okey, 804 10th st. n w.

Bookkeepers' Division—Chief, Thomas Rathbone, 218 2d st. n e.

Indian Division—Chief, Charles C. Snow, 1216 G st. nw.

Pay and Bounty Division—Chief, H. A. Whalion, Virginia.

Investigation of Frauds Division—Chief, F. H. Goodall, 914 P st. n w.

Property Division—Chief, Charles Lowell, 850 20th st. n w.

Ordnance, Medical, and Miscellaneous Division—Chief, A. H. Gambrill, 1111 11th st. n w.

THIRD AUDITOR.

Auditor—John S. Williams, 25 Lafayette square.

Deputy—William H. Welsh, Baltimore, Md.

Military Division—William S. Kiser, 2216 G st. n w.

Pensions Division—I. B. Hussey, 1434 Q st. n w.

Horse Claims—Oscar I. Harvey, 14 Fourth st. s e.

Claims—W. S. Stetson, 1412 Sixth st. n w.

Collection Division—Joseph R. Owens, Hyland station, B. and O.

Miscellaneous—I. A. Swartz, 126 E st. n w.

Bookkeepers' Division—J. F. Jones, 1120 N st. n w.

FOURTH AUDITOR.

Auditor—C. M. Snell, 1707 R. I. ave.

Deputy—Benjamin P. Davis, Pine street, Mount Pleasant, D. C.

Record and Prize Division—Chief, B. P. Limmack, 1501 S st. n w.

Navy Agents' Division—Chief, J. M. Wright, 1358 B st. s w.

Paymasters' Division—Chief, A. C. Ervin, 816 13th st. n w.

Pension Division—Chief, Richard Goodhart, 124 11th st s e.

Claim Division—Chief, Robert Kearon, 614 M st. n w.

Bookkeepers' Division—F. C. Severance, 1727 T st. n w.

FIFTH AUDITOR.

Auditor—Anthony Eickhof, 607 N. J. av.

Deputy—J. B. Mann, 1010 Mass. av.

Internal Revenue Collectors' Division—Chief, R. B. Detrick, Knowles' Station, Md.

Miscellaneous Division—Chief, Endicott King, 1318 16th st.

Diplomatic and Consular Division—Chief, A. O. Latham, 1306 R st.

TREASURER OF THE UNITED STATES.

Treasurer—C. N. Jordan, 1527 P st. n w.

Assistant Treasurer—J. W. Whelpley, 809 East Capitol st.

Chief Clerk—James F. Meline, Burnt Mills, Md.

Cashier—H. A. Whitney, 1222 11th st. n w.

Assistant Cashier—E. R. True, 933 N. Y. ave. n w.

Paying Teller—A. R. Quaiffe, The Portland.

Receiving Teller—William H. Gibson, 2435 K st. n w.

Assistant Teller—James C. Poynton, 478 O st. n w.

Assistant Teller—Gideon C. Bantz, Baltimore, Md.

Redemption Division—Chief, Charles H. Davidge, 1303 Q st. n w.

Loan Division—Chief, Ferdinand Weiler, 1316 V st. n w.

Accounts Division—Chief, D. W. Harrington, near Alexandria, Va.

Division of Issues—Chief, C. L. Jones, 1245 29th st. n w.

National Bank Division—Chief, Jerome C. Burnett, 206 5th st. s e.

Principal Bookkeeper—Sherman Platt, 1705 13th st. n w.

Assistant Bookkeeper—A. D. Johnson, 1332 V st. n w.

National Bank Redemption Agency—Superintendent, T. E. Rogers, 400 Spruce st., Le Droit Park.

COMPTROLLER OF THE CURRENCY.

Comptroller—Henry W. Cannon, 1323 K st n w.

Deputy Comptroller—John S. Langworthy, 201 Maple ave, Le Droit Park.

Division of Reports—Chief, Robert J. Mayfield, 713 E. Cap. st.

Redemption Division—Chief, A. B. Dickerson.

Division of Issues—Chief, Edward S. Peck, Mount Pleasant.

Organization Division—Chief (vacancy).

Bond Clerk—Wm. D. Swan.

COMMISSIONER OF INTERNAL REVENUE.

Commissioner—Joseph S. Miller, 1302 R. I. ave.

Deputy—H. C. Rogers, 1320 S st n w.

Solicitor—Charles Chesley, 641 East Capitol st.

Chief Clerk and Appointment Division—John D. Biddis, 1349 L st. n w.

Law Division—Assistant solicitor (see chief clerk).

Tobacco Division—Chief, Israel Kimball, 238 North Capitol st. n e.

Law Division—Chief, O. F. Dana, 1529 R. I. av.

Stamp Division—Chief, A. H. Holt, 1015 K st. n w.

Assessment Division—Chief, C. A. Bates, 1016 T st. n w.

Division of Distilled Spirits—Chief, T. C. Cushing, 605 F st. n w.

Division of Revenue Agents—F. D. Sewall, 1321 N. Y. ave.

DIRECTOR OF THE MINT.

Director of the Mint—James P. Kimball, 1311 N. H. ave.

Examiner—R. E. Preston, 53 K st. n e.

Computer of Bullion—E. O. Leech, 1510 S st. n w.

Assayer—Winfield P. Lawver, 1912 I st. n w.

Adjuster—Frank P. Gross, 1812 R st. n w.

BUREAU OF NAVIGATION.

Commissioner of Navigation—Jarvis Patten, 1114 13th st n w.

Acting Deputy Commissioner—Thomas B. Sanders, 1410 10th st.

LIGHTHOUSE BOARD.

Chairman—Vice Admiral Stephen C. Rowan, U. S. N., Ebbitt House.

Naval Secretary—Commander Henry F. Picking, U. S. N., 1708 H st n w.

Engineer Secretary—Maj. David Porter Heap, U. S. A., 1618 R. I. ave.

Chief Clerk—Arnold B. Johnson, Le Droit Park.

MARINE HOSPITAL SERVICE.

(Supervising Surgeon General's Office, 1441 G st. n w.)

Supervising Surgeon General—John B. Hamilton, 9 B st. n w., Capitol Square.

Chief Purveying Division—Surgeon George W. Stoner, 1201 G st. n w.

Acting Chief Clerk—Fairfax Irwin, passed assistant surgeon, 2131 K st. n w.

WAR DEPARTMENT.

Secretary of War—William C. Endicott, 1313 16th st. n w.

Chief Clerk—John Tweedale, 901 R st. n w.

Disbursing Clerk—E. M. Lawton, 1143 24th st. n w.

Record Division—Chief, S. Hodgkin, 312 Pa. av. n w.

Correspondence Division—Chief, Jay Stone, 1756 P st. n w.

Requisition and Accounts Division—Chief, L. W. Tolman, 914 East Capitol st.

Private Secretary and Stenographer—C. S. Sweet, 1317 M st. n w.

Officer on Duty—Capt. C. H. Hoyt, A. Q. M., U. S. A., 1511 16th st. n w.

NAVY DEPARTMENT.

Secretary of the Navy—Wm. C. Whitney, 1777 Mass. ave.

Chief Clerk—John W. Hogg, 1303 R st.

Disbursing Clerk—P. H. Stickney, Hopston, 7th st. road.

Registrar—Wm. P. Moran, 2112 Penn. ave.

Private Secretary and Stenographer—B. W. Hanna, 2218 G st.

OFFICE OF THE GEOLOGICAL SURVEY.

(Hooe Building, F st., bet. 13th and 14th n w.)

Director—J. W. Powell, 910 M st. n w.

Chief Clerk—James C. Pilling, 918 M st. n w.

Chief Disbursing Clerk—John D. McChesney, 1611 13th st. n w.

BUREAU OF LABOR.

(Kellogg Building, F st., bet. 14th and 15th n w.)

Commissioner—Carroll D. Wright, 1335 N st. n w.

Chief Clerk—Oren W. Weaver, 814 13th st. n w.